(2)

The University of the 21st Century

James J. Duderstadt, President
The University of Michigan

Meeting of the American Society for Information Science
Portland, Oregon
May 23, 1994

Introduction

Our subject for this morning's panel concerns "Themes for the 21st Century: Where are we going?" My remarks will concern possible futures for the university. This is a natural focus for our discussions. Most of you in this audience associated with universities in one way or another. Further, these institutions do represent an important paradigm of the knowledge-based organization and hence are particularly sensitive to the evolving infrastructure that characterizes the rapidly changing field of information science.

Let me begin by telling you about a little experiment we conducted last fall. Several groups were asked to assess the degree of change they believed the university would undergo during the 1990s using a scale of 0 to 10--with 0 meaning no change, the status quo, and 10 meaning radical change, a total reinvention of the University.

Most faculty tended to suggest relative modest change, in the range of 3 to 4 on the 10-point scale. Most academic administrators, deans and provosts and the like, believed there would be more radical change, on the order of 7 to 8 on the 10-point scale.

While at the AAU fall meeting, I asked a number of presidents of major research universities. Most of these responded, that on a scale of 0 to 10, the magnitude of the changes would be 20! Incidentally, that is also my own estimate of the amount of change the American university will experience in the decade ahead: 20, on a 10-point scale.

A Time of Change

One of civilization's most enduring institutions, the university has been quite extraordinary in its capacity to change and adapt to serve society. Far from being immutable, the university has changed quite considerably over time and continues to do so today. A simple glance at the remarkable diversity of institutions comprising higher education in America demonstrates this evolution of the species.

The profound nature of the challenges and changes facing higher education in the 1990s seems comparable in significance to two other periods of great change in the nature of the university in America: the period in the late nineteenth century when the comprehensive public university first appeared and the years following World War II when the research university evolved to serve the needs of postwar America.

A century ago, the industrial revolution was transforming our nation from an agrarian society into the industrial giant that would dominate the twentieth century. The original colonial colleges, based on the elitist educational principles

of Oxbridge, were joined by the land-grant public universities, which were committed to broad educational access and service to society. In the decades following this period, higher education saw a massive growth in merit-based enrollments in degree programs at the undergraduate, graduate, and professional level as the comprehensive university evolved.

A similar period of rapid change in higher education occurred after World War II. The educational needs of the returning veterans, the role of the universities in national defense, and the booming postwar economy led to an explosion in both the size and number of major universities. So too, the direct involvement of the federal government in the support of campus-based research led to the evolution of the research university as we know it today.

We now face challenges and opportunities similar to those characterizing these two earlier periods of transformation. Many point to negative factors, such as the rapidly growing costs of quality education and research during a period of limited resources, the erosion of public trust and confidence in higher education, or the deterioration in the partnership characterizing the research university and the federal government. But our institutions will be affected even more profoundly by the powerful changes driving transformations in our society, such as the increasing ethnic and cultural diversity of our people; the growing interdependence of nations; and the degree to which knowledge itself has become the key driving force in determining economic prosperity, national security, and social well-being.

And, of course, it is this last theme of change, accentuated by the extraordinary implications of the "digital age", that will stimulate the most profound changes in the university.

The Challenge of Change

We are living in the most remarkable of times. Who would have predicted a few years ago:

- the collapse of communism and the end of the Cold War
- the redefinition of the world economic order
- the direct manipulation of the human gene to cure disease
- the Internet phenomena, liking 25 million people worldwide
- digital convergence, in which communications and computer companies merge with the entertainment industry.

Yet all of these events have happened, and the pace of change continues to accelerate.

Indeed, many believe that we are going through a period of change in our civilization just as profound as that which occurred in earlier times such as

the Renaissance and the Industrial Revolution--except that while these earlier transformations took centuries to occur, the transformations characterizing our times will occur in a decade or less!

I used to portray the 1990s as the countdown toward a new millennium, as we found ourselves swept toward a new century by these incredible forces of change. But the events of the past several years suggest that the twenty-first century is already upon us, a decade early. We live in a time of breathtaking change, at a pace that continues to accelerate even as I speak.

This last point is very important, for today we are seeing a dramatic shift in the fundamental structure, nature, and perspective of our society. We are evolving rapidly into a society in which the key strategic resource necessary for prosperity and social well-being has become knowledge itself. In this world knowledge will play the same role that in the past was played by natural resources or geographic location or labor pools. Put another way, while forces such as land, guns, and money drove the past, ideas will be the driving force of the twenty-first century.

The "age of knowledge" in which we now find ourselves is accompanied by a fundamental transformation that is reshaping every product, every service, and every job throughout our nation and the world.

A Communications-Driven Society

In Michigan we have a unique vantage point from which to view the a particularly important feature of these changes. If there was one sector that most strongly determined the progress of the twentieth century, it was *transportation* and its related industries--cars, planes, trains, oil, space. Transportation determined prosperity, national security, even our culture--with the growth of the suburbs, international commerce, and so on. During this period Michigan's automobile industry had no equal, and the state rapidly became one of the most prosperous and powerful industrial regions on earth.

Today things are very different. We have entered a new era in which the engine of progress is not transportation but rather *communication*, enabled by the profound advances we are now seeing in computers, networks, satellites, fiber optics, and related technologies. We now face a world in which hundreds of millions of computers easily can plug into a global information infrastructure. Jacques Attali in his profound essay, *Millennium*,[1] suggested that the impact of information technology will be even more radical than that of the harnessing of steam and electricity in the nineteenth century. Rather it will be more akin to the discovery of fire by early ancestors, since it will prepare the way for a revolutionary leap into a new age that will profoundly transform human culture.

---

[1]Jacques Attali, Millennium

It is clear that information technology on which our knowledge-intensive society is increasingly dependent continues to evolve very rapidly. In the next several years we will see yet another 1,000-fold increase in the power of computers and networks. In the same time frame, massively parallel computation servers will offer tera-operations per second, while the price performance ratio of workstations will continue to improve. Within several years, widely available international networks capable of point-to-point multi-media (including video) will be available. Wide-area networks in the gigabit-per-second range will be in routine use, although still well short of the 25,000 gigabit potential of third generation fiber optic technology. Wireless communication will support remote computing and communication.

These rapidly evolving technologies are dramatically changing the way we collect, manipulate, and transmit information. Needless to say, the implications for our universities are profound. Let me illustrate with three themes:

Theme 1: The University as a Knowledge Server

One frequently hears the primary missions of the university referred to in terms of teaching, research, and service. But these roles can also be regarded as simply the twentieth century manifestations of the more fundamental roles of creating, preserving, transmitting, and applying knowledge. If we were to adopt the more contemporary language of computer networks, the university might be regarded as a knowledge server, providing knowledge services (i.e., creating, preserving, transmitting, or applying knowledge) in whatever form needed by contemporary society.

From this more abstract viewpoint, it is clear that while the fundamental *knowledge server* role of the university does not change over time, the particular realization of these roles do change--and change quite dramatically, in fact. Consider, for example, the role of "teaching"--that is, transmitting knowledge. While we generally think of this role in terms of a professor teaching a class of students, who, in turn, respond by reading assigned texts, writing papers, solving problems or performing experiments, and taking examinations, we should also recognize that classroom instruction is a relatively recent form of pedagogy. Throughout the last millennium, the more common form of learning was through apprenticeship. Both the neophyte scholar and craftsman learned by working as apprentices to a master. While this type of one-on-one learning still occurs today, in skilled professions such as medicine, and in advanced education programs such as the Ph.D. dissertation, it is simply too labor-intensive for the mass educational needs of modern society.

The classroom itself may soon be replaced by more appropriate and efficient learning experiences. Indeed, such a paradigm shift may be forced upon

the faculty by the students themselves. Today's students are members of the "multimedia" generation. They have spent their early lives surrounded by robust, visual, electronic media--Sesame Street, MTV, home computers, video games, cyberspace networks, and virtual reality. They approach learning as a "plug-and-play" experience, unaccustomed and unwilling to learn sequentially--to read the manual--and rather inclined to plunge in and learn through participation and experimentation. While this type of learning is far different from the sequential, pyramid approach of the traditional university curriculum, it may be far more effective for this generation, particularly when provided through a media-rich environment.

Hence, it could well be that faculty members of the "knowledge-server" university will be asked to set aside their roles as teachers and instead be asked to become "designers" of learning experiences, processes, and environments. Further, tomorrow's faculty may have to discard the present style of solitary learning experiences, in which students tend to learn primarily on their own through reading, writing, and problem solving. Instead they may be asked to develop collective learning experiences in which students work together and learn together with the faculty member becoming more of a consultant or a coach than a teacher.

One can easily identify other similarly profound changes occurring in the other roles of the university. The process of creating new knowledge--of research and scholarship--is also evolving rapidly away from the solitary scholar to teams of scholars, perhaps spread over a number of disciplines. Indeed, is the concept of the disciplinary specialist really necessary--or even relevant--in a future in which the most interesting and significant problems will require "big think" rather than "small think"? Who needs such specialists when intelligent software agents will be available to roam far and wide through robust networks containing the knowledge of the world, instantly and effortlessly extracting whatever a person wishes to know?

So, too, there is increasing pressure to draw research topics more directly from worldly experience rather than predominantly from the curiosity of scholars. Even the nature of knowledge creation is shifting somewhat away from the analysis of what has been to the creation of what has never been--drawing more on the experience of the artist than upon analytical skills of the scientist--but more on this in a moment.

The preservation of knowledge is one of the most rapidly changing functions of the university. The computer--or more precisely, the "digital convergence" of various media from print to graphics to sound to sensory experiences through virtual reality--has already moved beyond the printing press in its impact on knowledge. Throughout the centuries the intellectual focal point of the university has been its library, its collection of written works preserving the knowledge of civilization. Yet today, such knowledge exists in

many forms--as text, graphics, sound, algorithms, virtual reality simulations--and it exists almost literally in the ether, distributed in digital representations over worldwide networks, accessible by anyone, and certainly not the prerogative of the privileged few in academe.

Finally, it is also clear that societal needs will continue to dictate great changes in the applications of knowledge it excepts from universities. Over the past several decades, universities have been asked to play the lead in applying knowledge across a wide array of activities, from providing health care, to protecting the environment, from rebuilding our cities to entertaining the public at large (although it is sometimes hard to understand how intercollegiate athletics represents knowledge application).

The knowledge server theme for the university is not merely a possible paradigm for the future. Rather it is a paradigm which has existed throughout the long history of the university and will certainly continue to exist as long as these remarkable social institutions survive. But the particular realization of the fundamental roles of knowledge creation, preservation, transmission, and application will continue to change in profound ways, as they have so often in the past.

Theme 2: A Shift from Analysis to Creation

The professions that have dominated the late twentieth century--and to some degree, the late twentieth century university--have been those which manipulate and rearrange knowledge and wealth rather than create it, professions such as law, business, accounting, and politics. Yet it is becoming increasing clear that the driving intellectual activity of the twenty-first century will be the act of creation itself.

> "The winners of this new era will be creators, and it is to them that power and wealth will flow. The need to shape, to invent, and to create will blur the border between production and consumption. Creation will not be a form of consumption anymore, but will become work itself, work that will be rewarded handsomely. The creator who turns dreams into reality will be considered as workers who deserve prestige and society's gratitude and remuneration." Jacques Attali, *Millennium* [2]

Perhaps the determining characteristic of the University of the twenty-first century will be shift in intellectual focus from the preservation or transmission of knowledge to the process of creation itself. The tools of creation are expanding rapidly in both scope and power. Today we have the capacity to literally create objects atom-by-atom. We are developing the capacity to create new life-forms through the tools of molecular biology and genetic engineering. And we are now

---

[2]ibid., Attali

creating new intellectual "life forms" through artificial intelligence and virtual reality.

Hence, perhaps the university should structure itself in a more strategic fashion to nurture and teach the art and skill of creation. Perhaps we should form strategic alliances with other groups, organizations, or institutions in our society whose activities are characterized by great creativity (e.g., ... the Disney Company? . . .)

Theme 3: The Need to "Re-invent" the University

A third theme lies in the implications for existing social structures of knowledge-based organizations such as universities. It is clear that although the digital age will provide a wealth of opportunities for the future, we must take great care not simply to extrapolate the past, but instead to examine the full range of possibilities for the future.

But here we face a particular dilemma. Both the pace and nature of the changes occurring in our world today have become so rapid and so profound that our present social institutions--in government, education, the private sector--are having increasing difficulty in even sensing the changes (although they certainly feel the consequences), much less understanding them sufficiently to respond and adapt. It could well be that our present institutions, such as universities and government agencies, which have been the traditional structures for intellectual pursuits, may turn out to be as obsolete and irrelevant to our future as the American corporation in the 1950s. There is clearly a need to explore new social structures capable of sensing and understanding the change, as well as capable of engaging in the strategic processes necessary to adapt or control change.

Since the business of the university is knowledge, technology such as computers, networks, HDTV, ubiquitous computing, knowbots, and virtual reality may well invalidate most of the current assumptions and thinking about the future nature of the university. Some examples will illustrate this:

i) Will a "university of the 21st century" be localized in space and time, or will it be a "metastructure", involving people throughout their lives wherever they may be, on this planet or beyond?

ii) Will lifestyles in the academy (and elsewhere) become increasingly nomadic, with people living and traveling where they wish, taking their work and their social relationships with them?

In the spirit of these questions, perhaps we should pay far more attention to evolving new structures more appropriate for the evolving information technology. One example would be the "collaboratory" concept, envisioned as an

advanced, distributed infrastructure which would use multimedia information technology to relax the constraints on distance, time, and even reality. It would support and enhance intellectual teamwork. In fact, there is a growing consensus that the next major paradigm shift in computing is in the direction of the collaboratory and that not only research but a vast array of human team activities in commerce, education, and the arts would be supported by variants of this vision. Perhaps some form of the collaboratory is the appropriate infrastructure ("tooling") for the "learning organization" becoming popular in the business world; perhaps it is the basis for the world universities in the next century. It could well become the generic infrastructure on which to build the work place of the emerging information age.

But there are other possible paradigms of the university of the 21st century:

1. The World University: As a new world culture forms, a number of universities will evolve into learning institutions serving the world, albeit within the context of a particular geographical area (e.g., North America). Some questions:

- What would be the mission and character of a world university?
- Who, how, where would it teach?
- What programs would it stress? How would they be organized?
- What strategic alliances could be formed with other institutions?
- Would this be compatible with our state and national missions?

2. The Diverse University (or "Transversity"): A university drawing its intellectual strength and its character from the rich diversity of humankind, providing a model for our society of a pluralistic learning community in which people respect and tolerate diversity even as they live, work, and learn together as a community of scholars. Some questions:

- What society should we strive to represent? Our states? America? The world? The present? The future?
- What kind of diversity do we seek? Racial? Ethnic? Gender? Socioeconomic? Geographical? Intellectual? Political?
- How do we draw strength from diversity?
- How do we attempt to unite a diverse community?

3. The Cyberspace University: A university that spans the world (and possibly even beyond) as a robust information network linking together students, faculty, graduates, and knowledge resources. Some questions:

- Will the cyberspace university be localized in space and time or will it be a "meta structure" involving people throughout their lives, wherever they may be?

- Is the concept of the specialist (disciplines or professions) likely to remain relevant in such a knowledge-rich environment?
- Will knowledge become less of a resource and more of a medium in such a university?

4. The Creative University: As the tools for creation become more robust (e.g., creating materials atom-by-atom, genetically engineering new life forms, or computer-generating artificial intelligence or virtual reality), the primary activities of the university will shift from a focus on analytical disciplines and professions to those stressing creative activities (i.e., "turning dreams into reality"). Some questions:

- Will the "creative" disciplines and professions acquire more significance (e.g., art, music, architecture, engineering)?
- How does one nurture and teach the art and skill of creation?

5. The Divisionless University: The current disciplinary (and professional) organization of the University is viewed by many as increasingly irrelevant to their teaching, scholarship, and service activities. Perhaps the university of the future will be far more integrated and less specialized through the use of a web of virtual structures which provide both horizontal and vertical integration among the disciplines and professions. Some questions:

- Should we reverse the trend toward more specialized undergraduate degrees in favor of a "bachelors of liberal learning?"
- Has the Ph.D. itself become obsolete to the extent that it produces highly specialized clones of the present graduate faculty?
- Should the basic disciplines be mixed among the professions? Many of the most exciting problems have always been generated through interaction with the "real world."
- How do we develop, evaluate, and reward faculty who are generalists rather than specialists?

6. The University College: It seems clear that we need to develop a new paradigm for undergraduate education within the complex environment provided by a comprehensive research university. This "university college" should draw on the intellectual resources of the entire university: its scholars, libraries, museums, laboratories, graduate and professional programs, and its remarkable diversity of people, ideas, and endeavors. Some questions:

- Should we shift from solitary to collective learning experiences?
- How do we respond to the fact that the current generation of students is quite different from the faculty, both in cultural composition and styles of learning (e.g., the "plug and play" generation)?
- Should we require all faculty on our campuses--including those from professional schools--to become involved in undergraduate

education?

7. The Catholepistemiad: Since education will increasingly require a lifetime commitment, perhaps the University should reinvent itself to span the entire continuum of education, from cradle to grave. It could form strategic alliances with other components of the educational system, and commit itself to a lifetime of interaction with its students/graduates, providing them throughout their lives with the education necessary to meet their changing goals and needs. Some questions:

- How would this lifetime education be delivered?
- How would the university relate to other components of the educational continuum?
- How would this "seamless web" approach relate to our current focus on well-defined degree programs?

8. The New University: Could we create within our institutions a "laboratory" or "new" university that would serve as a prototype or test bed for possible features of the University of the twenty-first century? The "New U" would be an academic unit, consisting of students, faculty, and programs, with a mission of providing the intellectual and programmatic framework for continual experimentation. Some questions:

- Should the "New U" be a laboratory or proving ground for various possible visions of the university, or should it be a more permanent part of the university that we try to keep twenty or thirty years ahead of its time?
- Would the "New U" be a physical or virtual structure?
- Should the "New U" be built around research or service?
- How would we select student and faculty for the "New U?"

Of course, it is unlikely that our institutions will assume the form of any one of these models. But each paradigm has aspects that will almost certainly be a part of our character in the century ahead. And each paradigm suggests the extraordinary nature of the transformations that would be required in our universities in the years ahead. Just as they have so many times in the past, it is clear that our institutions must continue to change and evolve if we are to continue to serve--and, indeed, remain relevant to--a rapidly changing world.

The Transformation Process

So how does an institution as large, complex, and tradition-bound as the modern university go about transforming itself. Historically we have accomplished change using a variety of mechanisms: i) "buying" change with additional resources; ii) laboriously building the consensus necessary for grassroots support of change; iii) changing key people; iv) finesse, by stealth of

night; v) "Just doing it!," that is, top-down decisions followed by rapid execution (following the old adage that "it is better to seek forgiveness than to ask permission").

For the type of institutional transformation necessary to move toward the major paradigm shifts that will likely characterize higher education in the years ahead, we will need a more strategic approach capable of staying the course until the desired changes have occurred. Indeed, many institutions have already embarked on major transformation agendas similar to those characterizing the private sector. Some even use similar language as they refer to their efforts to "transform," "restructure," or even "re-invent" their institutions. But, of course, herein lies one of the great challenges to universities, since our various missions and our diverse array of constituencies give us a complexity far beyond that encountered in business or government. As a result, the process of institutional transformation is necessarily more complex.

Through the experience of organizations in both the private and public sector, several features of transformation processes should be recognized at the outset:

i) First, it is critical to define the real challenges of the transformation process properly. The challenge is usually not financial or organizational. Rather it is the degree of cultural change required. We must transform a set of rigid habits of thought and arrangements that are currently incapable of responding to change either rapidly or radically enough.

ii) It is important to achieve true faculty participation in the design and implementation of the transformation process, in part since the transformation of the faculty culture is the biggest challenge of all.

iii) It has been found that the use of an external group is not only very helpful but probably necessary to provide credibility to the process and assist in putting controversial issues on the table (e.g., tenure reform).

iv) Unfortunately, no universities--and few organizations in the private sector--have been able to achieve major change through the motivation of opportunity and excitement alone. Rather it has taken a <u>crisis</u> to get folks to take the transformation effort seriously--and sometimes even this is not sufficient.

v) The president must play a critical role both as a leader and as an educator in designing, implementing, and selling the transformation process, particularly with the faculty.

The necessary transformations will go far beyond simply restructuring finances to face the brave new world of limited resources. Rather, they will encompass every aspect of our institutions, including:

- the mission of the university
- financial restructuring
- organization and governance
- general characteristics of the university
- intellectual transformation
- relations with external constituencies
- cultural change

Universities, like most large, complex, and hierarchically organized organizations, tend to become bureaucratic, conservative, and resistant to change. Over time we have become encrusted with policies, procedures, committees, and organizational layers that tend to discourage risk-taking and creativity. We must take decisive action to streamline processes, procedures, and organizational structures to enable our institutions to better adapt to a rapidly changing world.

Concluding Remarks

There is an increasing sense among leaders of American higher education and on the part of our various constituencies that the 1990s will represent a period of significant change on the part of our universities if we are to respond to the challenges, opportunities, and responsibilities before us. A key element will be efforts to provide universities with the capacity to transform themselves into entirely new paradigms that are better able to serve a rapidly changing society and a profoundly changed world.

We must seek to remove the constraints that prevent our institutions from responding to the needs of a rapidly changing society, to remove unnecessary processes and administrative structures, to question existing premises and arrangements, and to challenge, excite, and embolden the members of our university communities to embark on this great adventure. Our challenge is to work together to provide an environment in which such change is regarded not as threatening but rather as an exhilarating opportunity to engage in the primary activity of a university, *learning*, in all its many forms, to better serve our world.

And this is where you come in. For I believe that the information and library science communities on our campus are uniquely situated to become important change agents both to ignite and guide the transformation process in our institutions. More specifically, universities need to be challenged, to sense the excitement and opportunity of the digital age, and to be exposed to visions of what may be possible.

That is your task. To educate. To challenge. And to excite.

Let's just do it!